Functional Materials for Energy

Academic Year: (2019 / 2020) **Review date: 24-04-2020**

Department assigned to the subject: Materials Science and Engineering and Chemical Engineering Department

Coordinating teacher: LEVENFELD LAREDO, BELEN

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Microscopy
Thermal and mechanical characterization

OBJECTIVES

The objective of this course is that the student knows the different systems of storage and production of energy in order to acquire capacities that allow him to understand the operation of some of the modern systems of storage and production of electrical energy and the importance that they have. the materials inside the device. Likewise, its repercussion in terms of environmental impact will be analyzed. To achieve this goal the student must acquire a series of knowledge, skills and attitudes.

With regard to knowledge, at the end of the course the student will be able to:
-Know the most current trends in the world of materials for energy in terms of their formulation and identify the potential advantages they can offer compared to more traditional materials.
-Design ways of optimization in the properties of different materials for specific applications through modifications in their structure and composition.
-To know advanced processing and synthesis systems that allow to obtain materials for energy with improved properties.
-To acquire knowledge and useful scientific-technical skills to solve specific problems associated with work in a laboratory in the field of materials for energy.

As for the specific abilities, at the end of the course the student will be able to:
- Know the requirements that materials for energy have to meet in specific applications.
- Within certain applications, know how to identify which materials are the most used today and know the alternatives that are contemplated at this time to achieve improved properties.
- Identify the necessary requirements for the selection of materials in some energy storage and production devices.
- Be able to evaluate the reasons why materials are used in particular applications.

DESCRIPTION OF CONTENTS: PROGRAMME

Introduction
Fuel Cells. Solid Oxide Fuel Cells.
Proton Exchange Membrane Fuel Cells I.
Proton Exchange Membrane Fuel Cells II.
Capacitors, Supercapacitors and Ferroelectrics.
Phase Change Materials
Redox Flow Batteries
Lithium Batteries
Post-Lithium Batteries
Superconductors
Magnetic Materials.
Characterization Techniques of Fuel cells.
Characterization Techniques of Batteries.

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES
Theoretical-practical classes
Laboratory practices
Tutorials

Team work
Individual work of the student

METHODOLOGY
Exhibitions in the teacher's class with support of computer and audiovisual means, in which the main concepts of the subject are developed and examples of resolution of exercises or practical cases are given
Critical reading by the student of scientific texts and publications recommended by the teacher
Obtaining experimental results in the laboratory. handling equipment and research techniques, under the guidance of the teacher
Preparation of works and reports individually or in groups

ASSESSMENT SYSTEM

Team Work: 40%
Exam: 60%

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- S.C. Singhal, K. Kendall High-temperature Solid Oxide Fuel Cells: Fundamentals, Design and Applications, Elsevier, 2003
- Vladimir S. Bagotsky, Alexander M. Skundin, Yurij M. Volfkovich Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors, John Wiley & Sons, 2015
- Yoshinobu Tanaka Ion Exchange Membranes: Fundamentals and Applications, Elsevier, 2015

ADDITIONAL BIBLIOGRAPHY

- Aiping Yu, Victor Chabot, Jiujun Zhang Electrochemical Supercapacitors for Energy Storage and Delivery: Fundamentals and Applications, CRC Press, 2013
- Ajay Kumar Saxena High-Temperature Superconductors, Springer Science & Business Media, , 2012
- David P. Wilkinson, Jiujun Zhang, Rob Hui, Jeffrey Fergus, Xianguo Li Proton Exchange Membrane Fuel Cells: Materials Properties and Performance, CRC Press, 2009
- J. M. D. Coey Magnetism and Magnetic Materials, Cambridge University Press,, 2010
- Masaki Yoshio, Ralph J. Brodd, Akiya Kozawa Lithium-Ion Batteries: Science and Technologies, Springer Science & Business Media, , 2010